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SYSTEM AND METHOD OF TRANSITIONING BETWEEN CELLULAR AND VOICE OVER INTERNET PROTOCOL COMMUNICATION

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FIELD OF THE DISCLOSURE

[0001] The present application relates in general to a combined cellular and voice over internet protocol mobile device and relates to methods of forwarding calls from a cellular network to a wireless local area network that supports voice over internet protocol.

BACKGROUND

[0002] Cellular telephone use is widespread and provides user convenience and mobility. However, cellular telephone use from a service provider perspective is often more expensive than traditional landline telephone service. In addition, service provider costs may be further reduced through the use of newer technology, such as computer network communications systems using the voice over internet protocol.

[0003] Accordingly, there is a need for a system and method for transitioning cellular phone traffic to lower cost telephony services.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 is a block diagram that illustrates a communications system including wireless local area network (LAN) stations for communicating with mobile devices.

[0005] FIG. 2 is a general diagram that illustrates further details of a communication between a wireless LAN and a representative mobile device that includes a cellular communications module and a wireless LAN interface module.

[0006] FIG. 3 is a flow chart that illustrates a method of handling call with respect to a wireless LAN

[0007] FIG. 4 is a flow chart that illustrates a method of forwarding cellular calls from a mobile communications device.

DESCRIPTION OF THE DRAWINGS

[0008] A multi-mode cellular and voice over internet protocol mobile device and a supporting network is disclosed. The mobile device includes a housing, an antenna, a wide area cellular communications module to provide wide area cellular communications, and a short-range wireless local area network module to provide a wireless communications interface to a wireless local area network having voice over internet protocol capability. In a particular embodiment, the internet protocol address and the port number of a wireless LAN base station is forwarded to and stored by the mobile phone device. In another embodiment, a method of forwarding a call from a mobile phone to a wireless LAN base station is disclosed. In another illustrative embodiment, a method of communicating from a wireless LAN base station to a mobile phone is disclosed. The method includes determining that the mobile phone is within range of a wireless LAN base station with voice over internet protocol (VoIP), retrieving an internet protocol address and port number of the wireless LAN base station, and sending the internet protocol address and the port number over a wireless fidelity communication link to the mobile phone.

[0009] Referring to FIG. 1, a communications system is illustrated. The communications system includes a first wireless LAN 110 having a first coverage area 112 and a second wireless LAN 106 having a second coverage area 108. The first wireless LAN 110 is coupled to a LAN station 102 via a computer network connection. The LAN station 102 is coupled to another illustrative computer network node, LAN station 104. LAN station 104 is coupled to the second wireless LAN 106. A first representative mobile phone 122 is located outside of the first wireless LAN coverage area 112 so that the mobile phone 122 is not in range to communicate with the first wireless LAN 110. A second representative mobile phone 120 is located within the second coverage area 108, such

that the mobile phone 120 is in range for communication with the second wireless LAN base station 106. One or more of the LAN stations may be coupled to an external network. For example, in FIG. 1, the LAN station 102 is coupled to an external wired network 130, such as the internet, via a communications link 132, such as a digital subscriber line (DSL) or other suitable connection. The external wired network 130 may be coupled to other external networks that are not illustrated, such as the public switched telephone network and the public wide area cellular network.

[0010] The system also includes a LAN, WAN or internet 134 coupled to the LAN stations 102, 104, and a VoIP provider 136 coupled to the LAN, WAN, or internet 134. The VoIP provider 136 is also coupled to the public switched telephone network 138. The LAN or WAN 134 or any of the LAN stations 102, 104 may include personal computer (PC) phone software 142, such as NetMeeting, Net2Phone, and PhoneFree. LAN Station 102 may be coupled to a wired VoIP phone 140.

[0011] If the VoIP provider 136 is connected directly to the Local Area Network (LAN) 134, then calls originating and terminating on the LAN would stay within the LAN and would not go over the PSTN 138. This includes calls where one end is the new mobile phone 120, 122 and the other end is any of the following: 1) another of the new mobile phones within range of a wireless base-station on the LAN, 2) a wired VoIP Phone on the LAN, or 3) PC Phone Software 142 on the LAN 104.

[0012] If the VoIP provider 136 is connected directly to the Wide Area Network (WAN), then calls originating and terminating on the WAN would stay within the WAN and would not go over the PSTN 138. This includes calls where one end is the new mobile phone 120, 122 and the other end is any of the following: 1) another of the new mobile phones within range of a wireless base-station on the WAN, 2) a wired VoIP Phone 140 on the WAN, or 3) PC Phone Software 142 on the WAN 134.

[0013] If the VoIP provider 136 is connected to the internet 130, then calls originating and terminating on the internet 130 would stay within the internet and would not go over the PSTN 138. This includes calls where one end is the new mobile phone 120, 122 and the other end is any of the following: 1) another of the new mobile phones within range

of a wireless base-station on the internet 134, 2) a wired VoIP Phone on the Internet, or 3) PC Phone Software 142 on the internet.

[0014] If the call originates or terminates with a telephone on the PSTN 138, whether the wireline or cellular network, then the VoIP provider 136 would need to perform the VoIP translation from PSTN to IP and IP to PSTN.

[0015] During operation, a mobile communications device that is within range of a wireless LAN, such as the illustrated mobile phone 120 that is within range of the second wireless LAN 106, may transition communications from an external communication mechanism, such as provided by the cellular phone network, to short-range communication within the wireless LAN coverage area 108. Once the opportunity for short-range communication is detected, either the system or the mobile phone device may initiate the transition to the short-range communication technique. Often, short-range communications using a wireless LAN can provide for a clearer communications channel for voice traffic at a lower cost than the cellular wide area network. Also, the short-range communications provided by the wireless LAN may be located within a building or in areas where cellular coverage is not available.

[0016] Referring to FIG. 2, a sample short-range communication between the wireless LAN 106 and the mobile phone 120 is illustrated. The wireless LAN base station 106 includes a memory that contains an internet protocol address 208, and optionally a local port number. The combination of the internet protocol address and the port number uniquely identifies a communication path for short-range communications with a particular mobile device, such as to the mobile phone 120. The wireless LAN 106 also includes an antenna 220 to provide for wireless communications and includes a network interface to communicate with a wired network element. The illustrated network interface 210 is coupled to the digital subscriber line access multiplexer (DSLAM) 202 via a DSL line 204. In a particular embodiment, the VoIP to wireline interface may be located close to the DSLAM to reduce internet lag time and to thereby provide for improved voice communications.

[0017] Referring to FIG. 2, the mobile phone 120 is a combined cellular phone and voice over internet protocol (multi-mode) communication device to provide short-range wireless LAN and cellular wide area communications. The mobile phone 120 includes a housing and an antenna 230 attached to the housing. The housing includes various electronic elements including various integrated circuits and connector elements assembled on one or more printed circuit boards. The combined mobile communications device 120 includes a wireless LAN communications module 212 and a cellular communications module 214. The mobile communications device 120 may also include a cellular network messaging module 216. An example of network messaging is the short message service (SMS) used with cellular phones for text messages. The wireless LAN communications module 212, the cellular communications module 214 and the network messaging module 216 may be implemented as separate semiconductor devices (e.g. separate cellular, GPRS, and 802.11 chip sets) or some portion of such functions may be integrated using computer software or firmware into a microprocessor or other similar digital processing device. Programming of the mobile phone, including VoIP provider internet protocol addresses, user identification and passwords, and wireless LAN user identification and passwords, may be accomplished using a computer connected to the mobile phone through the wireless network.

[0018] Referring to FIG. 3, a method of communicating from a wireless LAN base station to a mobile communications device is shown. The mobile communications device, such as mobile phone 120, is detected entering the coverage area of the wireless LAN base station, at 300. The detection of the mobile phone 120 may be determined by the communication of a response message from the mobile phone 120 to a broadcast communicated by the wireless LAN base station. An example of data message communication is provided in the wireless fidelity communications standard IEEE 802.11. The wireless LAN issues an internet protocol address to the mobile phone, such as by use of the dynamic host configuration protocol (DHCP), at 302. The mobile phone connects to the VoIP provider, sending any required user identification and password, at 303, and may receive an optional port number to use. The mobile phone sends the internet protocol address of the VoIP provider and the optional port number to a remote

cellular network in communication with the mobile phone, at 304. The forwarding of such information may be communicated as part of a call forwarding message, such that the cellular network is directed to forward subsequent calls having a destination of the mobile phone to instead be routed to the VoIP provider through the wireless LAN as identified by the internet protocol and the port number.

[0019] A call having a destination corresponding to the mobile phone, such as a forwarded call redirected from the cellular network, is received by a wired network coupled to the wireless LAN and then received at the wireless LAN, at 306. Upon receipt of the incoming call, the wireless LAN establishes a short-range wireless communication with the mobile phone, such as by use of the voice over internet protocol, at 308. The incoming call is then connected to the short-range communication path to establish a connection between an originator of the call and the destination mobile phone, via the intermediate wireless LAN. Two way communications, such as a telephone voice call and/or data messaging, is then provided over the voice over internet protocol communication path that was previously established.

[0020] Upon completion of the call, the short-range wireless connection and the computer network wired connections are retained. In addition, if the mobile phone moves outside the range of the wireless LAN, the call would either be lost or preferably, the call would be transitioned back to another communications channel, such as the wide area cellular network. The transition of the call from the wireless LAN to the cellular network may be implemented using a mechanism similar to the handoff methods that are used to handle the transition of cellular calls between different cellular base stations of the cellular network. In some embodiments, data within the cellular network may be updated dynamically to handle call transitions between the cellular network and the short-range wireless LAN network. Such data handling may be performed using the visitor and home location registers of the cellular network.

[0021] Referring to FIG. 4, a method of forwarding cellular calls to wireless LAN calls is illustrated. The mobile phone is detected as being within range of a wireless LAN base station, such as via the 802.11 protocol, at 402. The mobile phone receives an internet

protocol address of the wireless LAN base station, such by use of the dynamic host configuration protocol (DHCP), at 404, and establishes a connection with a VoIP provider, at 405. The mobile phone stores the internet protocol and the port number into a computer readable memory. The mobile phone sends a call forwarding request to a remote wide area network to forward future calls directed to the mobile phone using the VoIP provider and wireless LAN instead of the cellular network, at 406. After establishing call forwarding, a voice over internet protocol call is received by the mobile phone from the VoIP provider through the wireless LAN base station. Bidirectional communication is then available over the wireless LAN network without further use of cellular network minutes and the associated costs of the cellular call, at 408. At 410, the mobile phone detects an out of range condition with respect to the coverage area of the supporting wireless LAN. The mobile phone removes the call forwarding request so that subsequent calls are sent directly to the mobile phone using the cellular network instead of the wireless LAN. In addition, the current call may be transitioned to the cellular network using a call handoff.

[0022] A system and method of providing cellular and short-range wireless communications has been disclosed. The disclosed system may be used to reduce the cost of operating a cellular phone from a service provider perspective and may save subscriber cellular minutes. In addition, the disclosed method of automatically routing cellular calls over VoIP through use of a local wireless LAN base station may beneficially reduce cellular congestion conditions, when a user is located near a supporting wireless LAN base station. Improved call clarity may also be provided depending on the location of the user.

[0023] The above disclosed subject matter is to be considered illustrative, and not restrictive, and the appended claims are intended to cover all such modifications, enhancements, and other embodiments which fall within the true spirit and scope of the present invention. Thus, to the maximum extent allowed by law, the scope of the present invention is to be determined by the broadest permissible interpretation of the following claims and their equivalents, and shall not be restricted or limited by the foregoing detailed description.